FOCUS ON

POWDER COATINGS

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A MONTHLY REPORT FROM SID HARRIS

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THE IMPORTANCE OF PIGMENTS IN POWDER COATINGS

Following IntertechPira's highly successful Future of Pigments Conference, several of the papers are abstracted in this issue and it is intended to provide other brief abstracts in later issues. The first abstract, however, relates to technical progress in powder binder resins from the viewpoint of DSM Powder Coating Resins. The article confines its main comments to the development of low temperature thermal curing powder – a subject in which DSM's expertise and products have placed them in the prime position as the largest global supplier of powder resins. While I agreed with the main observations made in this article I did disagree with the adverse comments concerning the current performance of UV curable powder coatings – an area of resin development that has not yet attracted the commercial interest of DSM. I concede that some of the products available in the early stage of development were completely unsuitable for a powder coating that would not be capable of thermal cure. In my own laboratory assessment of one commercial UV powder resin, the formulation consistently gelled at the extrusion stage since it was obviously based on an amorphous polymer structure. The semi-crystalline structure I eventually selected gave excellent flow due to its low melt viscosity, and was thoroughly cured at high film thicknesses and high pigment loading. I am not yet convinced that improving low temperature curing powder resins is the way ahead!

A brief extract of a discussion involving a number of industry experts confirms my own belief that UV/EB curing will eventually be the main process in the industrial coatings market and that powder coatings will become the most favoured coatings contender.

The industry leaders continue to consolidate their interests in this economic downturn and the customer's choice of powder coatings supplier continues to be reduced. The latest move by Akzo Nobel to absorb the powder coatings interests of Dow Chemical will, no doubt, improve their standing in the US market, even though it reduces the customer's freedom of choice.

Sid Harris

TECHNICAL

A powder coating progress review

A recent article by JM Verlaak of DSM Powder Coatings described resin developments that have benefited applicators, end users and the environment. He observed that powder coatings have historically scored very high in terms of the '4Es' – economy

and ease of application, excellence of finish and ecology. Recent resin developments offer further gains in the key properties. They include lower temperature cure, better appearance in thin films, elimination of the pretreatment stage and the potential for a resin based on renewable resources. In support of the ease of application factor he cited the simplicity of powder application and easy colour changes requiring no cleaning solvents. Excellence of finish is now claimed for recent resin technology, which has contributed to significant improvements in appearance standards. Powder is by far the most economical method of applying coatings and the cost per coated article is significantly lower than that of alternative paint systems. Although the plant costs are high, the total painting cost per article is at least 50% less than that of liquid paint. This is due to its single layer application, no overspray waste and its complete freedom from volatile components. On the question of ecology, worker safety, lack of VOC emissions, and CO_2 footprint are prime factors. Energy costs for stoved powder coatings are high but considerable progress has been made in reducing cure temperatures or the dwell time in the oven. The author claims that this explains the success of powder coatings and its dominant position in metal coating and his vision for the future is "When a substrate can be powder coated, it will be".

Powder coating technology has improved and it will improve even more with attention being paid to improving overall efficiency. The key areas for improvement are: faster cure, thinner films, simplifying pretreatment, improving efficiency of application, improved appearance, improved exterior durability, improving sustainability and improving curing temperatures. The article then considers these targets in greater detail.

There are several ways in which formulators can effect faster cure but the current trend is towards developing improved resins such as faster curing polyester-epoxy hybrid systems or a faster cure for hydroxyalkylamide (HAA) systems, whilst retaining good flow and film properties. Thinner films have a direct impact on the CO_2 footprint but the problem is the risk of increasing the orange peel effect, which is aggravated by the need for a higher pigment loading to give adequate hiding power. Flow additives and wetting agents can improve this problem but they often adversely affect storage stability or film hardness. The Uralac HiTone allows for higher pigment loading while maintaining or improving on flow and levelling properties and without compromising Tg.

Prior to applying a coating, the metal surface is degreased and phosphated. If the phosphating step could be avoided or if iron phosphating could replace zinc phosphating then this would eliminate the need for a less environmentally friendly treatment and reduce costs. There is a possibility that corrosion protection would not be compromised by a new pretreatment technology using nanotechnology or silane technology provided by pigment/additive suppliers or resin manufacturers. Another possibility is the Uralac Corres technology, which allows the pretreatment stage to be omitted without diminishing corrosion resistance. This process was also found to be an effective replacement for chrome treatments on aluminium substrates. The wider use of IR heating methods would also reduce energy costs using smaller ovens heated by either electric or gas fuelled IR emitters.

A criticism of powder coatings has been the poorer flow and appearance of powder coatings when compared to liquid coatings. Uralac HiTone technology improves pigment wetting, resulting in a much better film appearance. Replacing the extremely durable PVDF polymers is a challenge that many resin suppliers are working on to develop less expensive and more environmentally friendly polymers. Improved durability together with easy-to-clean qualities is a target that will also require the efforts of pigment producers for there are only a limited number of exterior durable pigments at the present time.

Recently, resin producers have begun designing resins for powder coatings that are based on renewable resources and a resin for powder coatings using HAA crosslinker has already been introduced. To be completely sustainable the resin and all other components in the coating must be renewable or recyclable, including the additives, crosslinkers, pigments and extenders. Reducing the cure cycle of powder coatings will allow the development of new market opportunities for coating of wood, plastic, glass and composites of both metal and plastics. Low temperature curing of epoxy powder is a reality but there are problems with yellowing in decorative applications. Polyester/epoxy hybrids can be made to achieve a cure cycle of 10-15 minutes at 130°C but they require formulation modifications to reduce the tendency to orange peel and the storage stability of these products is poor due to their high reactivity. The author claims that UV curable powders have never lived up to their promise since the high melt viscosity at low temperatures limits the film flow. He also claims that UV powder is difficult to cure on 3D articles and films that are thick or highly pigmented. A recent alternative low temperature curing system is based on an amorphous polyamide resin with a curing cycle of 15 minutes at 130°C. This product is claimed to give excellent overall film properties such as extreme flexibility and excellent chemical resistance.

In conclusion, it is postulated that the real breakthrough will only occur when powder coatings are capable of curing at temperatures below 100°C.

Article entitled "Broader Scope for Powder Coatings" by Jos Verlaak of DSM Powder Coating Resins published in European Coatings Journal, Dec 2009, 86-89

Radiation curing on the increase

A panel of international experts was invited by RadTech Europe to express their opinions on the market trends and growth potential for radiation curing coatings. All experts agreed that both UV and EB are still in the growth phase and the full potential is nowhere near to completion. While the global economic crisis has stifled the early promise for these materials it is predicted that the growth market for radiation cured systems in Europe will remain at about 3% per annum, the prediction for market growth in Asia is expected to be far in excess of 7%.

The growth drivers are: the acceptance that UV/EB curing is an efficient and economical manufacturing process, enabling high quality coatings capable of meeting demanding applications. It is an environmentally friendly technology, which offers energy saving options for applicators. There are still technical challenges such as the development of techniques to coat 3D objects and the economical challenge of investment needed for capital equipment.

Article entitled "Radiation Curing on the Rise" by Marc Macare published in European Coatings Journal, Dec 2009, 106-107

Advances in pigments technology

Following the successful Pigments Forum held in Hamburg several interesting papers were presented in the technical section. Some of these abstracts may be of use to powder coatings formulators.

The first abstract relates to "Colour shift pigments based on titanium" by John E Book of JDSU. The speaker began by describing the interference colour theory. If two parallel light beams are in phase and of the same wavelength then they are able to interact with each other creating a condition of reinforcement or (constructive interference), and forming a new single wave with double amplitude. Total cancellation or (destructive interference) occurs when two beams are out of phase by a factor of a half wavelength, while other conditions of phase shifts will give intermediate interference results. These metal-dielectric pigments operate when white light is separated into its individual colour components by selective destructive and constructive interference, and viewing the effect from different angles produces different colours. A typical metal-dielectric pigment design comprises a first layer of a semi-transparent absorber metal, such as chromium, followed by a thicker layer of a glass like material (magnesium fluoride) then an opaque reflector metal is deposited (aluminium) and completed by another layer of magnesium fluoride and a final layer of chromium. Since there is a regulatory question concerning the use of chromium, JDSU have replaced the chromium layers with titanium. This substitution gives comparable appearance although work is still needed to improve durability. The total five layer thickness is approximately one micron.

A useful paper that merits attention by powder coating formulators is the Ciba presentation "The Future of Pigments". It is too lengthy to be abstracted but it does contain much information about regulatory issues and the work that is currently being directed to new pigments based on natural raw materials, and structural changes that will modify some existing pigments to meet regulatory compliance.

A presentation on fluorescent pigments by Dr Rami Ismael of Radiant Colour NV describes the current techniques for producing these materials. Almost 99% of these effects are produced by dissolving solid dyes in a carrier resin. The overall effect is largely influenced by the carrier resin and, to a lesser extent, by the dye and the physical and chemical interaction between the dye and the carrier resin. Problems relating to the older generations of fluorescent pigments include: their low light stability which affects outdoor applications; migration of low molecular weight fractions from the resin preventing their use in cosmetics and causing them to plate out in moulding applications; bleeding of the dyes which limits food approvals and adds cost for top barrier coats; the resin contained formaldehyde that is not acceptable for many end uses; alternative resins have low solvent resistance; and the dyes are mainly insoluble in oils. Dr Ismael then compares the existing products to a new system that his company hope to introduce commercially in 2010 or 2011. The is based on a dye modified polymer, which is crosslinked to the dye and surface modified to give high colour intensities in a high molecular weight polymer, offering high tintorial strength, with good optical and migration properties.

Abstracts taken from IntertechPira's Future of Pigments Conference in Hamburg, Germany, 3-5 Nov 2009, e-mail: veronica.fricova@pira-international.com

INDUSTRY NEWS

Ferro reports 3Q 2009 results: performance coatings

Ferro Corp's net sales from its performance coatings segment dropped to $129,499,000 in the three months ended 30 Sep 2009 from $162,523,000, in the three months ended 30 Sep 2008,